CHEMISTRY 1B (CHEM1102) - November 2009

2009-N-2

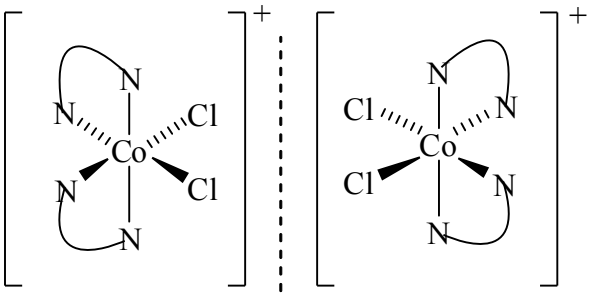
- The acidity of oxo-acids increases as the number of oxygens increases. The electronegative oxygen atoms in $SO_2(OH)_2$ and $SO(OH)_2$ pull the electron density in the molecule towards themselves, thus weakening the O–H bonds. This effect is more pronounced in H_2SO_4 than in H_2SO_3 due to the extra O atom. H_2SO_4 therefore has the weaker O–H bond and is thus the stronger acid.

  Paramagnetism is the property of a compound to be attracted by an external magnetic field. It is a characteristic of any compound with unpaired electrons. *d*-Block elements have from 1 to 10 electrons in the *d*-orbitals. When forming compounds, some of these may be lost to give paramagnetic species. Species with odd numbers of electrons must be paramagnetic, species with even numbers of *d*-electrons, may or may not be paramagnetic. eg

Cu^{2+}, d^9	↑↓	↑↓	↑↓	↑↓	↑	must be paramagnetic
Zn^{2+}, d^{10}	↑↓	↑↓	↑↓	↑↓	↑↓	must be diamagnetic
Fe^{2+}, d^6	↑↓	↑	↑	↑	↑	is paramagnetic

- *cis*-dichloridobis(ethylenediamine)cobalt(III) chloride or
  cis-dichloridobis(ethane-1,2-diamine)cobalt(III) chloride

  Yes, it is chiral as it is not superimposable on its mirror image.



2009-N-3

- 2.61

  7.91

  3.22

  Solution A (the acid)

2009-N-4

- $FeCO_3(s) \rightarrow Fe^{2+}(aq) + CO_3^{2-}(aq)$

  5.3×10^{-4} g L^{-1}

- 2×10^{-22} M

  CO_2 dissolves in water to give acidic solution that reacts with OH^- ions.

  $$2OH^-(aq) + CO_2(aq) \rightarrow CO_3^{2-}(aq) + H_2O$$

  From Le Chatelier's principle, the decrease in $[OH^-]$ will result in an increase in $[Fe^{3+}]$.

2009-N-5

- 2

  rhombic, monoclinic and vapour (at 96 °C and 0.0043 mmHg)
  B: monoclinic, liquid and vapour (at 119 °C and 0.027 mmHg)

  solid rhombic

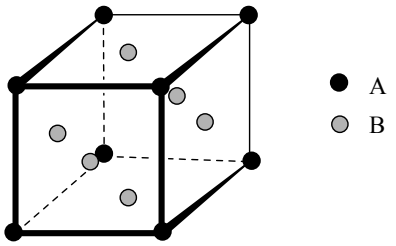
  no

  Rhombic The equilibrium line between rhombic and monoclinic slopes to the right. If you begin in the monoclinic region close to this line and you increase the pressure, you will cross the line vertically and go into the rhombic region. As rhombic is more stable at higher pressure, it must be more dense than monoclinic.

  rhombic → monoclinic → vapour (Follow a horizontal line drawn midway between the 2 triple points.)

2009-N-6

- AB_3 A= $8(^1/_8) = 1$; B= $6(^1/_2) = 3$



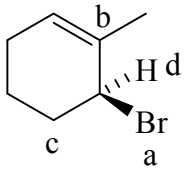
- $Pb^{2+} + EDTA^{4-} \rightleftharpoons [Pb(EDTA)]^{2-}$ $\quad K_1 = \dfrac{[Pb(EDTA)^{2-}]}{[Pb^{2+}][EDTA^{4-}]}$

  $Ca^{2+} + EDTA^{4-} \rightleftharpoons [Ca(EDTA)]^{2-}$ $\quad K_2 = \dfrac{[Ca(EDTA)^{2-}]}{[Ca^{2+}][EDTA^{4-}]}$

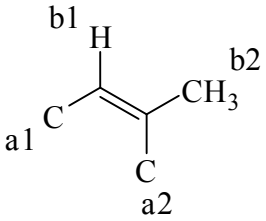
  K_1 must be greater than K_2 for the therapy to be effective.
  $[Ca^{2+}]$ is much greater than $[Pb^{2+}]$ in the body, so need $K_1 > K_2$ to form the Pb complex.
  If EDTA is not administered as the Ca complex, it will strip Ca^{2+} from the body.

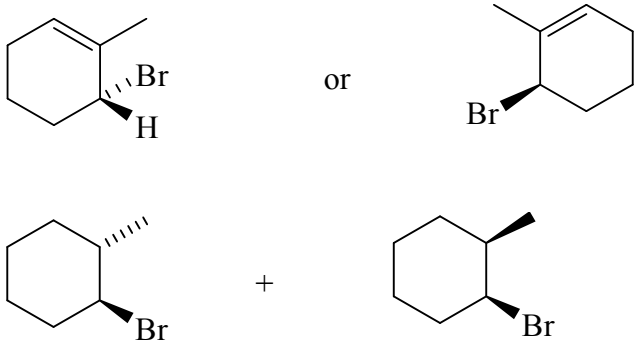
2009-N-7

- (*S*) The four groups at the stereogenic centre are assigned priorities based on atomic numbers. Br has highest priority, H the lowest. The carbon labelled b, C(C,C,C) has higher priority than the carbon labelled c C(C,H,H) by examining the atoms attached to them. With d at the back, a→b→c is anticlockwise, so the configuration is (*S*).



(*Z*) Compare the priorities of the two groups at each end of the double bond: i.e. a1 with b1 and a2 with b2. The two low priority groups (b) are on the same side of the double bond, so the configuration is (*Z*).





diastereomers

2009-N-8

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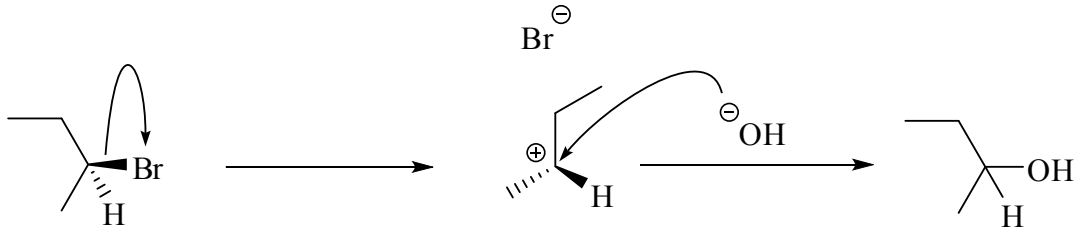


A **B** **C**

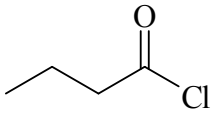
S_N1 reaction (nucleophilic substitution, unimolecular)

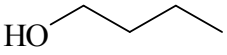
The product is racemic because the intermediate carbocation (**B**) is planar. Attack by OH^- is therefore equally likely from either top or bottom, leading to equimolar amounts of the two enantiomers.

CH_3CH_2COCl or $(CH_3CH_2CO)_2O$

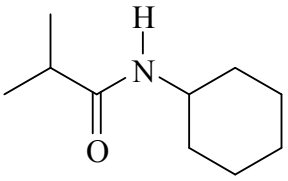
2009-N-9

- $SOCl_2$ 1. $LiAlH_4$ / dry ether 2. H^+ / H_2O

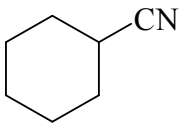


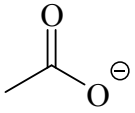


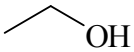
2009-N-10

- 

+ CH_3OH





+ 

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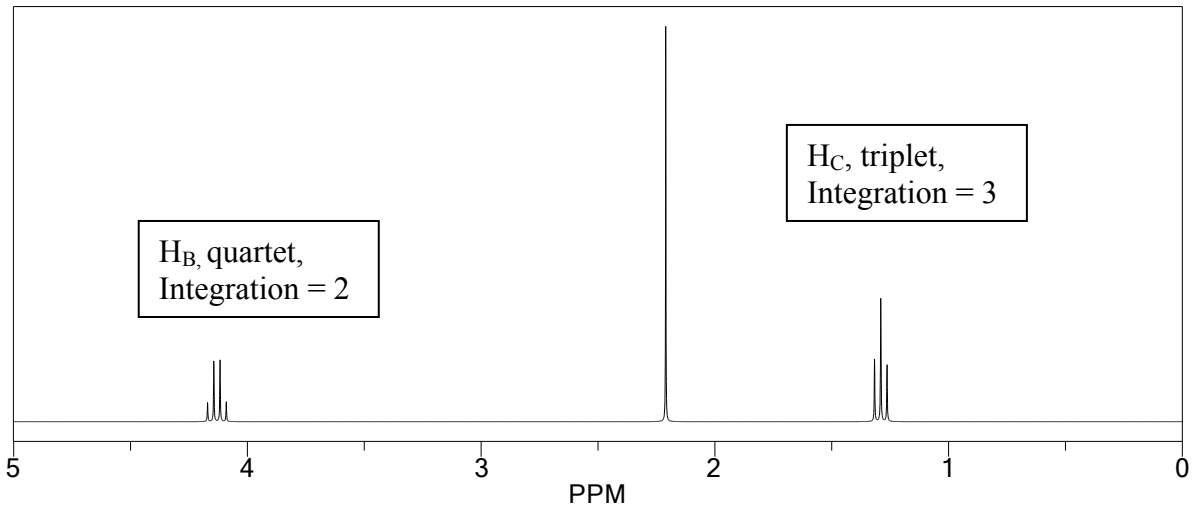
- 

2009-N-12

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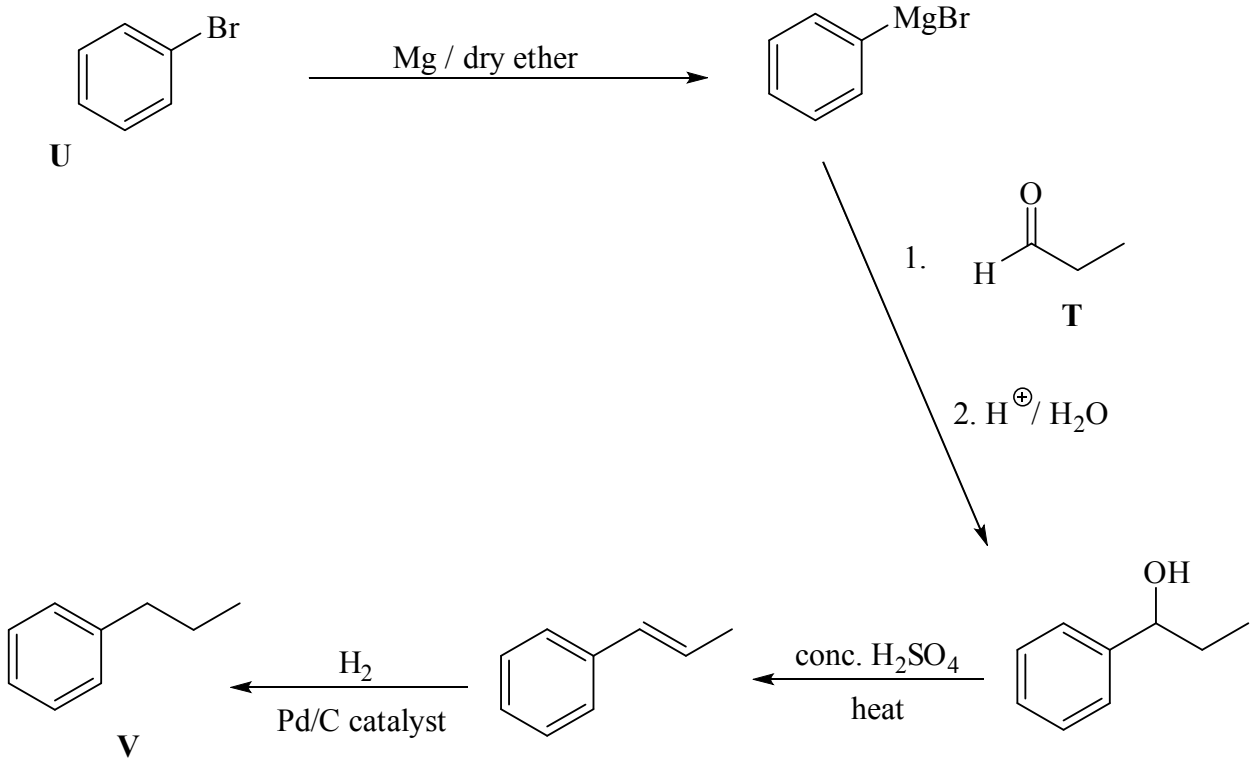
Br
U
Mg / dry ether
MgBr
1.
O
H
T
2. H⊕/ H2O
OH
conc. H2SO4
heat
H2
Pd/C catalyst
V